Beaufort Sea Play 15: Brookian Unstructured Eastern Turbidite

Geological Assessment

GRASP UAI: AAAAABAY
Play Area: 3605 square miles
Play Water Depth Range: 5 – 150 feet
Play Depth Range: 4800 – 25000 feet
Play Exploration Chance: 0.490

Play 15, Brookian Unstructured Eastern Turbidites, Beaufort Sea OCS Planning Area, 2006 Assessment, Undiscovered Technically-Recoverable Oil & Gas

Assessment Results as of November 2005

Resource Commodity (Units)	Resources *		
	F95	Mean	F05
BOE (Mmboe)	0	168	533
Total Gas (Tcfg)	0.000	0.250	0.787
Total Liquids (Mmbo)	0	123	393
Free Gas** (Tcfg)	0.000	0.168	0.529
Solution Gas (Tcfg)	0.000	0.082	0.258
Oil (Mmbo)	0	116	369
Condensate (Mmbc)	0	7	24

** Risked, Technically-Recoverable*

*** Free Gas Includes Gas Cap and Non-Associated Gas*

F95 = 95% chance that resources will equal or exceed the given quantity

F05 = 5% chance that resources will equal or exceed the given quantity

BOE = total hydrocarbon energy, expressed in barrels-of-oil-equivalent, where 1 barrel of oil = 5,620 cubic feet of natural gas

Mmb = millions of barrels

Tcf = trillions of cubic feet

Table 1

Play 15, the "Brookian Unstructured Eastern Turbidite" play, contains 1% of the Beaufort Sea province hydrocarbon endowment (mean of 168 Mmboe). The overall assessment results for play 15 are shown in table 1. Liquid hydrocarbons make up 73% of the endowment. Table 5 reports the detailed assessment results by commodity for play 15.

Table 3 summarizes the volumetric input data developed for the *GRASP* computer model of Beaufort Sea play 15. Table 4 reports the risk model used for play 15. The location of play 15 is shown in figure 1.

The play includes Late Cretaceous and Tertiary prodelta shales and turbidites of the Canning Formation. It is located on the relatively unstructured part of the shelf between the Barrow arch and the hinge line fault zone and lies east of the eastern stratigraphic limit of the Torok Formation (east of the Colville River delta). It underlies much of the Brookian Unstructured Eastern Topset play (play 13). Reservoirs include turbidite sandstones, enclosed by shales, mostly deposited in submarine fan environments. Source rocks include relatively gas-prone shales of the Canning Formation, and rich oil-prone shales of the Hue Shale and Pebble Shale units. The base of the play sequence lies in direct contact with these source beds. Stratigraphic traps predominate, although small scale fault traps also occur. Marine shales that enclose turbidite sandstones provide good seals. The McCovey #1 well tested amplitude and AVO anomalies within the Canning turbidite section in this play. The well encountered generally low permeability fine sands, saturated with oil but was determined to be non-economic. The OCS Y-191 (Beechy Pt. #2) well in Steffanson Sound flowed oil and gas out of the Canning Formation. Onshore, oil has been tested in turbidite sands of the Canning Formation in the Badami field (estimated recoverable reserves, 100 to 150 MMbbl oil (Petroleum News April 1997)) and in similar

rocks in the Flaxman Island area. The primary risk factors for this play are the presence of closure and reservoir facies.

Play 15, Brookian Unstructured Eastern Turbidites, Beaufort Sea OCS Planning Area, 2006 Assessment, Conditional BOE Sizes of Ten Largest Pools			
Assessment Results as of November 2005			
Pool Rank	BOE Resources *		
	F95	Mean	F05
1	19	136	468
2	9	49	128
3	5	27	69
4	2.7	17	43
5	1.6	11	29
6	1.02	8	21
7	0.76	6	16
8	0.61	5	13
9	0.52	4	10
10	0.46	3	9

** Conditional, Technically-Recoverable, Millions of Barrels Energy-Equivalent (Mmboe), from "PSRK.out" file*

F95 = 95% chance that resources will equal or exceed the given quantity

F05 = 5% chance that resources will equal or exceed the given quantity

BOE = total hydrocarbon energy, expressed in barrels-of-oil-equivalent, where 1 barrel of oil = 5,620 cubic feet of natural gas

Table 2

A maximum of 18 hypothetical pools is forecast by the aggregation of the risk model and the prospect numbers model for play 15. These pools range in mean conditional (un-risked) recoverable volumes from 1 Mmboe (pool rank 18) to 136 Mmboe (pool rank 1). Pool rank 1 ranges in possible conditional recoverable volumes from 19 Mmboe (F95) to 468 Mmboe (F05). Table 2 shows the conditional sizes of the 10 largest pools in play 15.

Table 6 reports statistics for the simulation pools developed in the *GRASP* computer model for play 15. In the computer simulation for the play, a total of 54,071 "simulation pools" were sampled for size.

These simulation pools can be grouped according to the USGS size class system in which sizes double with each successive class. Pool size class 9 contains the largest share (10,466, or 19%) of simulation pools (conditional, technically recoverable BOE resources) for play 15. Pool size class 9 ranges from 8 to16 Mmboe. The largest pool among the 54,071 simulation pools falls within pool size class 16, which ranges in size from 1,024 to 2,048 Mmboe.

GRASP Play Data Form (Minerals Management Service-Alaska Regional Office)

Basin: Beaufort | **Assessor**: Johnson/Scherr | **Date**: 10/17/2005
Play Number: 15 | **Play Name**: Brookian Unstructrured Eastern Turbidite
Play UAI Number: AAAAABAY

Play Area: mi² (million acres) 3605 (2307.0)
Reservoir Thermal Maturity: % Ro

Play Depth Range: feet	4800	11,000	25000
Expected Oil Gravity: ° API	30		
Play Water Depth Range: feet	5	30	150

POOLS Module (Volumes of Pools, Acre-Feet)

Fractile	F100	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Prospect Area (acres)-Model Input	180	380		1050	2200		3900			15000	22000		30000
Prospect Area (acres)-Model Output													
Fill Fraction (Fraction of Area Filled)	0.1	0.15		0.29	0.5		0.75			0.95		0.99	1
Productive Area of Pool (acres)	21	132	207	439	1014	2130.513/3302.898	2340	3665	4966	7792	12935	18136	28145
Pay Thickness (feet)	7.0	21.9	26.6	36.9	53.0	61.486/36.492	76.2	92.6	105.6	128.4	160.0	185.3	392.0

MPRO Module (Numbers of Pools)

Play Level Chance	0.7	**Prospect Level Chance**	0.7	**Exploration Chance**	0.49

Risk Model	Play Chance	Petroleum System Factors	Prospect Chance
		Presence of Closure	0.7
	0.7	Presence of Reservoir Facies	

Fractile	F99	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Numbers of Prospects in Play	6.00	7.00	7.60	8.70	10.20	11.04/2.53	12.00	13.30	14.00	15.20	16.70	17.90	18.00
Numbers of Pools in Play				0@F70	6	5.41/4.05	8	9	10	11	13	13	18

Minimum Number of Pools	0	**Mean Number of Pools**	5.41	**Maximum Number of Pools**	18

POOLS/PSRK/PSUM Modules (Play Resources)

Fractile	F100	F95	F90	F75	F50	Mean/Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Oil Recovery Factor (bbl/acre-foot)	57	83	100	136	191	216.292/112.345	269	323	366	440	542	622	623
Gas Recovery Factor (Mcfg/acre-foot)	244.0	349.3	422.9	582.2	830.4	949.762/511.684	1184.6	1433.3	1630.7	1974.5	2448.9	2826.9	2827.0
Gas Oil Ratio (Sol'n Gas)(cf/bbl)	68	229	283	404	600	715.843/470.258	891	1102	1272	1574	2000	2347	5309
Condensate Yield ((bbl/Mmcfg)	7.60	19.21	22.58	29.61	40.00	44.286/21.197	54.04	63.51	70.85	83.31	99.98	112.90	210.20

Pool Size Distribution Statistics from *POOLS* (1,000 BOE): μ (mu)= 9.36207419 σ^2 (sigma squared)= 2.00694481
Random Number Generator Seed= 054137

BOE Conversion Factor (cf/bbl)	5620	**Probability Any Pool Contains Both Oil and Free Gas (Gas Cap)**	1
Probability Any Pool is 100% Oil	0	**Fraction of Pool Volume Gas-Bearing in Oil Pools with Gas Cap**	0.25
Probability Any Pool is 100% Gas	0		

Table 3. Input data for Beaufort Sea play 15, 2006 assessment.

Risk Analysis Form - 2006 National Assessment

Assessment Province:	Beaufort	**Play Number, Name:**	15, Brookian Unstructrured Eastern Turbidite
Assessor(s):	Johnson/Scherr	**Play UAI:**	AAAAABAY
Date:	20-Oct-05		

For each component, a *quantitative* probability of success (i.e., between zero and one, where zero indicates no confidence and one indicates absolute certainty) based on consideration of the *qualitative* assessment of **ALL** elements within the component was assigned. This is the assessment of the probability that the minimum geologic parameter assumptions have been met or exceeded.

			Play Chance Factors	Averge Conditional Prospect Chance[1]
1.	**Hydrocarbon Fill component** (1a * 1b * 1c)	**1**	***1.0000***	***1.0000***
a.	**Presence of a Quality, Effective, Mature Source Rock**			
	Probability of efficient source rock in terms of the existence of sufficient volume of mature source rock of adequate quality located in the drainage area of the reservoirs.	1a	1.00	1.00
b.	**Effective Expulsion and Migration**			
	Probability of effective expulsion and migration of hydrocarbons from the source rock to the reservoirs.	1b	1.00	1.00
c.	**Preservation**			
	Probability of effective retention of hydrocarbons in the prospects after accumulation.	1c	1.00	1.00
2.	**Reservoir component** (2a * 2b)	**2**	***0.7000***	***1.0000***
a.	**Presence of reservoir facies**			
	Probability of presence of reservoir facies with a minimum net thickness and net/gross ratio (as specified in the resource assessment).	2a	0.70	1.00
b.	**Reservoir quality**			
	Probability of effectiveness of the reservoir, with respect to minimum effective porosity, and permeability (as specified in the resource assessment).	2b	1.00	1.00
3.	**Trap component** (3a * 3b)	**3**	***1.0000***	***0.7000***
a.	**Presence of trap**			
	Probability of presence of the trap with a minimum rock volume (as specified in the resource assessment).	3a	1.00	0.70
b.	**Effective seal mechanism**			
	Probability of effective seal mechanism for the trap.	3b	1.00	1.00
Overall Play Chance (Marginal Probability of hydrocarbons, MPhc)			***0.7000***	
	(1 * 2 * 3) *Product of All Subjective Play Chance Factors*			
Average Conditional Prospect Chance[1]				***0.7000***
	(1 * 2 * 3) *Product of All Subjective Conditional Prospect Chance Factors*			
	[1] Assumes that the Play exists (where all play chance factors = 1.0)			
	Must be consistent with play chance and prospect distribution -- See discussion on Page 3 of Guide			
Exploration Chance			***0.4900***	
	(Product of Overall Play Chance and Average Conditional Prospect Chance)			

Comments: *See guidance document for explanation of the Risk Analysis Form*

Table 4. Risk model for Beaufort Sea play 15, 2006 assessment.

GRASP - Geologic and Economic Resource Assessment Model - PSUM Module Results

Minerals Management Service - Alaska OCS Region
GRASP Model Version: 8.29.2005)
Computes the Geologic Resource Potential of the Play

Play UAI:	**AAAAABAY**		**Play No.**		**15**		
World	Level	-	World	Level		Resources	
Country	Level	-	UNITED	STATES		OF	AMERICA
Region	Level	-	MMS	-		ALASKA	REGION
Basin	Level	-	**BEAUFORT**	**SHELF**			
Play	**Level**	**-**	**Play**		**15**	**Brookian**	**Unstructured**
Geologist	Peter	Johnson				**Eastern**	**Turbidite**
Remarks	Play	15	2005	assessment			
Run Date & Time:		Date	19-Sep-05	Time	13:50:15		

Summary of Play Potential

Product	MEAN	Standard Deviation
BOE (Mboe)	167,540	196,080
Oil (Mbo)	115,570	139,130
Condensate (Mbc)	7,441	9,567
Free (Gas Cap & Nonassociated) Gas (Mmcfg)	167,860	201,120
Solution Gas (Mmcfg)	82,392	112,220

10000 (Number of Trials in Sample)
0.6997 (MPhc [Probability] of First Occurrence of Non-Zero Resource)
Windowing Feature: used

Empirical Probability Distributions of the Products

Greater Than Percentage	BOE (Mboe)	Oil (Mbo)	Condensate (Mbc)	Free (Gas Cap & Nonassociated) Gas (Mmcfg)	Solution Gas (Mmcfg)
100	0	0	0	0	0
99.99	0	0	0	0	0
99	0	0	0	0	0
95	0	0	0	0	0
90	0	0	0	0	0
85	0	0	0	0	0
80	0	0	0	0	0
75	0	0	0	0	0
70	7,319	4,918	346	8,207	3,341
65	58,090	38,860	2,833	63,823	28,327
60	81,079	55,617	3,555	83,516	39,603
55	100,960	69,289	4,566	105,520	46,830
50	120,890	84,386	5,050	119,590	57,173
45	141,410	96,682	6,835	148,400	64,579
40	162,390	111,560	7,602	167,180	75,721
35	186,800	127,600	8,350	192,720	93,055
30	212,830	148,950	9,228	206,600	100,580
25	244,040	168,890	10,366	248,470	115,600
20	281,420	194,700	12,735	285,980	129,840
15	334,290	231,940	14,840	321,770	169,990
10	407,130	282,370	17,666	396,330	205,540
8	443,570	308,530	20,319	438,750	205,980
6	494,130	344,280	20,901	495,370	229,370
5	532,940	368,580	24,330	529,120	257,840
4	577,680	399,090	25,228	558,120	303,790
2	733,830	521,410	28,923	666,450	364,810
1	909,400	645,110	35,005	802,830	485,760
0.1	1,476,600	1,144,200	27,621	726,580	985,950
0.01	1,843,000	1,415,200	88,657	1,148,000	757,830
0.001	2,178,500	1,669,800	50,131	1,779,800	797,290

Table 5. Assessment results by commodity for Beaufort Sea play 15, 2006 assessment.

Basin: BEAUFORT SHELF
Play 15 - Brookian Unstructured Eastern Turbidite
UAI Key: AAAAABAY

Model Simulation "Pools" Reported by "Fieldsize.out" *GRASP* Module

Classification and Size				Pool Count Statistics				Pool Types Count			Mixed Pool Range		Oil Pool Range		Gas Pool Range		Total Pool Range			Pool Resource Statistics (MMBOE)			
Class	Min (MMBOE)	Max (MMBOE)	Pool Count	Percentage	Trial Average	Trials w/Pool Avg		Mixed Pool	Oil Pool	Gas Pool	Min	Max	Min	Max	Min	Max	Min	Max		Min	Max	Total Resource	Average Resource
1	0.0312	0.0625	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
2	0.0625	0.125	32	0.059181	0.0032	0.004573		32	0	0	1	1	0	0	0	0	1	1		0.068093	0.124742	3.203518	100.109950
3	0.125	0.25	185	0.342143	0.0185	0.026436		185	0	0	1	2	0	0	0	0	1	2		0.126453	0.248969	35.722835	193.096414
4	0.25	0.5	523	0.967247	0.0523	0.074736		523	0	0	1	2	0	0	0	0	1	2		0.250711	0.499943	199.405689	381.272823
5	0.5	1	1489	2.753787	0.1489	0.212775		1489	0	0	1	3	0	0	0	0	1	3		0.500198	0.999996	1123.921000	754.815996
6	1	2	3626	6.705997	0.3626	0.518148		3626	0	0	1	5	0	0	0	0	1	5		1.000192	1.999882	5408.883000	1.491694
7	2	4	6334	11.714228	0.6334	0.905116		6334	0	0	1	7	0	0	0	0	1	7		2.000396	3.999674	18817.463000	2.970866
8	4	8	9271	17.145975	0.9271	1.324807		9271	0	0	1	7	0	0	0	0	1	7		4.000937	7.999979	54167.617000	5.842694
9	8	16	10466	19.356031	1.0466	1.49557		10466	0	0	1	6	0	0	0	0	1	6		8.000052	15.999074	121145.490000	11.575147
10	16	32	9120	16.866713	0.912	1.303229		9120	0	0	1	7	0	0	0	0	1	7		16.000120	31.985256	208184.058000	22.827200
11	32	64	6766	12.513177	0.6766	0.966848		6766	0	0	1	5	0	0	0	0	1	5		32.002013	63.994207	304286.828000	44.972927
12	64	128	3758	6.950121	0.3758	0.537011		3758	0	0	1	5	0	0	0	0	1	5		64.026548	127.983889	334127.571000	88.911011
13	128	256	1736	3.210593	0.1736	0.248071		1736	0	0	1	4	0	0	0	0	1	4		128.026487	255.369305	304938.527000	175.655838
14	256	512	614	1.135544	0.0614	0.087739		614	0	0	1	2	0	0	0	0	1	2		256.047869	511.808084	210625.892000	343.038910
15	512	1024	136	0.251521	0.0136	0.019434		136	0	0	1	2	0	0	0	0	1	2		513.843899	1003.573000	92966.907000	683.580200
16	1024	2048	15	0.027741	0.0015	0.002143		15	0	0	1	1	0	0	0	0	1	1		1041.395000	1965.449000	19351.917000	1.290128
17	2048	4096	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
18	4096	8192	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
19	8192	16384	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
20	16384	32768	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
21	32768	65536	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
22	65536	131072	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
23	131072	262144	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
24	262144	524288	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
25	524288	1048576	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
Not Classified			0	0	0	0	Below Class	0	0	0									Below Class	0.000000	0.000000	0.000000	0.000000
		Totals	**54071**	**100**	**5.4071**	**7.726635**	Above Class	0	0	0									Above Class	0.000000	0.000000	0.000000	0.000000

Number of Pools not Classified: 0
Number of Pools below Class 1: 0
Number of Trials with Pools: 6998

Min and Max refer to numbers of pools of the relevant size class that occur within any single trial in the simulation.

Min and Max refer to aggregate resources of the relevant size class that occur within any single trial in the simulation.

Table 6. Statistics for simulation pools created in computer sampling run for Beaufort Sea play 15, 2006 assessment.

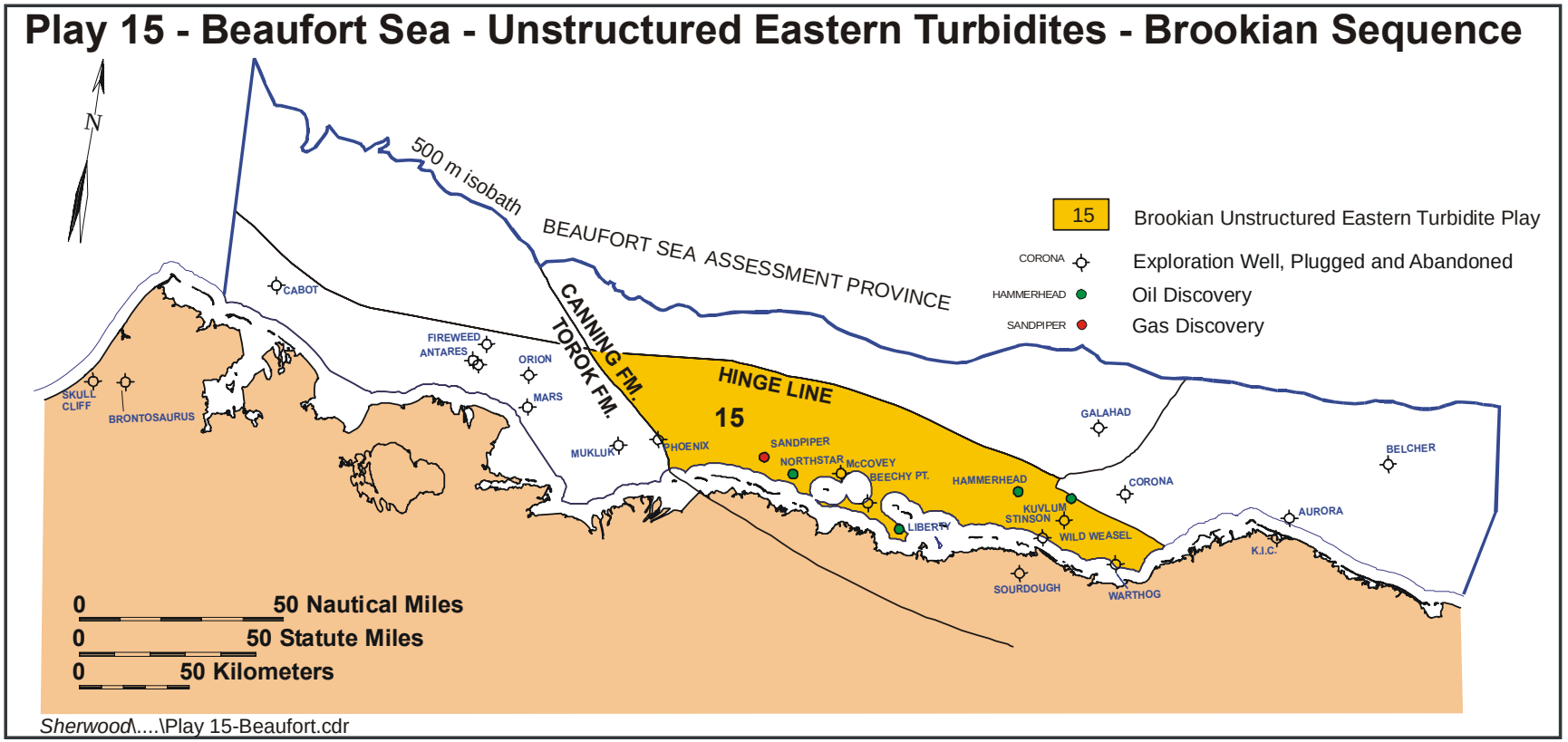

Figure 1. Map location of Beaufort Sea play 15, 2006 assessment.